



A VISUAL APPROACH TO PERCENTS

MaTHink 2012

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Session goals

- Explore visual and sense-making approaches to percent problems
- Build a bridge to sophisticated proportional reasoning
- Make connections to CCSS Standards for Mathematical Practice and Content
- Examine draft CCSS-aligned assessment items on percent increase/decrease

CCSS Standards for Mathematical Practice

1. **Make sense of problems and persevere in solving them**
2. **Reason abstractly and quantitatively**
3. **Construct viable arguments and critique the reasoning of others**
4. **Model with mathematics**
5. **Use appropriate tools strategically**
6. **Attend to precision**
7. **Look for and make use of structure**
8. **Look for and express regularity in repeated reasoning**

Comparing Content Standards: 7th Grade Standards from 1997 Framework

- NS 1.7 Solve problems that involve discounts, markups, commissions, and profit and compute simple and compound interest.
- Jason bought a jacket on sale for 50% off the original price and another 25% off the discounted price. If the jacket originally cost \$88, what was the final sale price that Jason paid for the jacket? (CST released test question, 2004)

Comparing Content Standards: 7th Grade Standards from CaCCSS-M

- Domain: Ratios and Proportional Relationships (RP)
- Cluster: Analyze proportional relationships and use them to solve real-world and mathematical problems
- Standard 7RP3. Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

Percent Strips

- A simple visual tool for modeling percent problems
- Clean copies available on MaTHink wikispace



Try this

Gwen fills her kiddie pool with a garden hose. The pool has straight sides and water comes out of the hose at a steady rate. After 1 minute and 30 seconds, she notices it is 30% full. How long will it take to completely fill the pool?



Using a Strip

Gwen fills her kiddie pool with a garden hose. The pool has straight sides and water comes out of the hose at a steady rate. After 1 minute and 30 seconds, she notices it is 30% full. How long will it take to completely fill the pool?



Using a Ratio Table

Gwen fills her kiddie pool with a garden hose. The pool has straight sides and water comes out of the hose at a steady rate. After 1 minute and 30 seconds, she notices it is 30% full. How long will it take to completely fill the pool?

Time (min:sec)	Percent Full
0:30	10
1:30	30
5:00	100

“Reasoning up and down”

Try These. How would you show the solution using percent strips? Using the ratio table?

- A school had 420 students in Algebra I. If 20% of the students in Algebra I got a B or better, how many Algebra I students got a B or better?
- A pair of shoes that originally cost \$86 is now on sale at a 35% discount. What is the sale price of the shoes?
- Sylvestre had pizza delivered and his bill came to \$24. If he wants to tip the driver 15% of the bill, how much money should he give the driver?
- Furry Friends had 50 pets in its store. 70% of the pets were dogs. The rest were hamsters. When more dogs arrived later that day, the percentage of hamsters in the store decreased to 25%. How many dogs were delivered to the pet shop? Assume no animals were sold during the day.

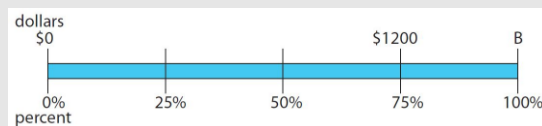
Percent Challenges

- A box of low-fat crackers announces “30% less fat per serving (compared to regular crackers)!” The nutritional information on the box of low-fat crackers says that one serving has 3.5 grams of fat. How many grams of fat are in one serving of regular crackers?
- The Gizmo Manufacturing Company is having a hard time. The president makes an offer to the employees: If they agree to a 10% pay cut now, we won’t lay anyone off. Then, when business improves, everybody will get a 10% raise. Will the employees be back to their original salary, or more or less than their original salary? Explain why.

CCSS Learning Progression for Ratios and Proportional Reasoning

Solving a percent problem

If 75% of the budget is \$1200, what is the full budget?



“I said 75% is 3 parts and is \$1200
 25% is 1 part and is $\$1200 \div 3 = \400
 100% is 4 parts and is $4 \cdot \$400 = \1600 ”

portion	75	3	1200
whole	100	4	1600

$$75\% \text{ is } \frac{1200}{B}$$

$$\frac{75}{100} = \frac{1200}{B}$$

$$B = 1600$$

$$75\% \text{ of } B \text{ is } 1200$$

$$\frac{75}{100} \cdot B = 1200$$

In reasoning about and solving percent problems, students can use a variety of strategies. Representations such as this, which is a blend between a tape diagram and a double number line diagram, can support sense-making and reasoning about percent.

<http://commoncoretools.me/category/progressions/>

Draft Assessment Items from Smarter Balanced Assessment Consortium

Sale prices

Max bought 2 items in a sale.

One item was 10% off.

One item was 20% off.

Max says he saved 15% altogether. Is he right? Explain.



<http://www.smarterbalanced.org/>

Draft Assessment Items from Smarter Balanced Assessment Consortium

CR2: 25% Sale

In a sale, all the prices are reduced by 25%.

1. Julie sees a jacket that cost \$32 before the sale.
How much does it cost in the sale?

\$ _____

Show your calculations.



In the second week of the sale, the prices are reduced by 2% of the previous week's price.
In the third week of the sale, the prices are again reduced by 2% of the previous week's price.
In the fourth week of the sale, the prices are again reduced by 2% of the previous week's price.

Draft Assessment Items from Smarter Balanced Assessment Consortium

2. Julie thinks this will mean that the prices will be reduced to \$0 after the four reductions because

$$4 \times 25\% = 100\%.$$

Explain why Julie is wrong.

3. If Julie is able to buy her jacket after the four reductions, how much will she have to pay?

\$ _____

Show your calculations.

Julie buys her jacket after the four reductions.
What percentage of the original price does she save?

_____ %

Show your calculations.

CCSS Standards for Mathematical Practice

- | | |
|---|---|
| 1. Make sense of problems and persevere in solving them | Mathematics |
| 2. Reason abstractly and quantitatively | 5. Use appropriate tools strategically |
| 3. Construct viable arguments and critique the reasoning of others | 6. Attend to precision |
| 4. Model with | 7. Look for and make use of structure |
| | 8. Look for and express regularity in repeated reasoning |

Thank you!

Teachers are the key to changing the way students learn mathematics.

- Dana & Yendol-Silva